

Internalizing and Externalizing Classes in Posttraumatic Stress Disorder: A Latent Class Analysis

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Using latent class analysis (LCA) the typology of personality profiles of veterans with posttraumatic stress disorder (PTSD) was examined based on internalizing/externalizing dimensions of psychopathology. Latent class analysis on Minnesota Multiphasic Personality Inventory-2 (MMPI-2) Personality Psychopathology-5 (PSY-5) scale data from 299 Australian combat veterans with PTSD supported the model, identifying an optimal 4-class solution, with PTSD externalizing class defined by aggressiveness and disinhibition, high and moderate internalizing classes differentiated on the extent of elevations in introversion and negative emotionality and elevation of psychoticism in the high internalizing class and a simple PTSD class with normal range scores. The model was validated using external self-report and psychiatric-interview-derived diagnoses. A second exploratory LCA using broader comorbidity indicators (MMPI-2 Restructured Clinical scales) demonstrated some support for, although limitations in, using nonpersonality measures to identify these classes directly.

Posttraumatic stress disorder (PTSD) is associated with very high levels of comorbidity, with around 85% of men and 80% of women with PTSD also meeting criteria for another Axis 1 condition, most commonly depression, other anxiety disorders and substance use disorders (Creamer, Burgess, & McFarlane, 2001; Kessler, Sonnega, Hughes, & Nelson, 1995). The extensive comorbidity consistently identified between mental disorders has given rise to increased interest and research into psychopathological-and/or temperamental-related latent factors that potentially account for the observed covariation between these disorders.

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One of the more prominent models of the structure of psychiatric comorbidity and its relation to dimensions of temperament was proposed by Krueger (1999). Using the National Comorbidity Survey data, Krueger (1999) found an internalizing/externalizing model best fitted the data. The internalizing factor included the anxiety and mood disorders and the externalizing factor included antisociality and substance abuse disorders. The internalizing/externalizing model has now also been replicated using data from national epidemiological studies in the Netherlands (Vollebergh et al., 2001), Australia (Slade & Watson, 2006), and a large U.S. Department of Veterans Affairs sample (Miller, Fogler, Wolf, Kaloupek, & Keane, 2008).

Alongside the above research a separate stream of investigation has attempted to identify subgroups of PTSD sufferers that vary along characterological and/or temperamental dimensions using measures of personality and psychopathology such as the Minnesota Multiphasic Personality Inventory (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989) and the Millon Clinical Multiaxial Inventory (Millon, Millon, & Davis, 1994). Using cluster analytic techniques, subgroups of combat veterans with PTSD have been identified that have been labelled as aggressive stress, dependent stress, and subclinical (Piekarski, Sherwood, & Funari, 1993), antisocial, detached/self-defeating, subclinical, and global (Hyer, Davis, Albrecht, Boudewyns, & Woods, 1994),

disinhibition/externalization, somatization/introversion and sub-clinical (Forbes et al., 2003), and nonclinical, anxious and depressed, and exaggerated (Elhai, Frueh, Davis, Jacobs, & Hamner, 2003).

Although it was possible to draw out common features among the differing subgroups identified in these studies, such as the aggressive stress group of Piekarski et al. (1993), the disinhibition/externalizing group (Forbes et al., 2003), and Hyer's anti-social group, a difficulty in integrating the findings of the above research was the absence of a unifying model of personality and psychopathology upon which to conceptualize these subgroups. In this context, Miller, Greif, and Smith (2003) drew on the work of Krueger (1999) and sought to test whether clinically meaningful subtypes differing in propensities towards internalizing versus externalizing comorbidity would be observed within a PTSD sample. Using similar cluster analytic techniques with U.S. combat veteran data drawn from the Multidimensional Personality Questionnaire (Tellegen, 1985), Miller et al. (2003) identified three subgroups, two of which were best represented as either internalizing or externalizing and a third that reported normal range personality scale scores and fewer comorbid diagnoses. The Multidimensional Personality Questionnaire profile for the externalizing group was characterized by low constraint and harm avoidance and high alienation and aggression. The Multidimensional Personality Questionnaire profile of the internalizing group was defined by lower positive emotionality, alienation, and aggression, and higher constraint. Miller, Kaloupek, Dillon, and Keane (2004) reported a similar pattern in a group of combat veterans using the MMPI-2 PSY-5 scales (Harkness, McNulty, & Ben-Porath, 1995). Using the PSY-5 scales, the externalizing group was represented by elevations in aggressiveness and disinhibition and the internalizing group was represented by elevations in introversion. Both the internalizing and externalizing PTSD groups, however, reported elevations in negative emotionality. Sellbom and Bagby (2009) have also replicated this three-group structure using cluster analytic methods on PSY-5 data from a sample of workplace trauma survivors. Miller and Resick (2007) also reported the three-group finding in a sample of sexual assault survivors using the Schedule of Adaptive and Non-Adaptive Personality (Clark, 1996). They described these groupings as two "complex" clusters consistent with internalizing and externalizing and a third "simple" PTSD group characterized by PTSD with normal range personality scores.

The consistent findings of a third subgroup, which has been called "simple PTSD" (Miller & Resick, 2007) or "subclinical" (Forbes et al., 2003; Hyer et al., 1993; Piekarski et al., 1994) is also worthy of comment. This is a group who report "normal range" scores on measures of personality psychopathology and consequently, despite being undifferentiated from the two other groups on the level of trauma exposure, appear to have less (or less severe) comorbidity. In conceptualizing this group, the absence of more severe personality pathology of either an internalizing or externalizing variety accounts for the negligible comorbidity profile.

Importantly, to date all the above research identifying subgroups has used cluster analytic techniques. In the last few years there has been increased development and use of latent class analysis (LCA) in the identification of groups of individuals varying along relevant dimensions. Latent class analysis is a type of general mixture cluster analysis which, though similar to traditional K-means cluster analysis, performs better as it does not assume the restrictive requirement of equal variances across classes/clusters (often violated in practice). Latent class analysis also offers objective indices of class classification accuracy (e.g., entropy) that are not available in traditional cluster analysis methods. Latent class analysis offers robust, empirically supported tests to determine the optimal number of classes (Nylund, Asparouhov, & Muthén, 2007).

This study sought to test the internalizing/externalizing model of personality-based PTSD subtypes (herewith referred to as classes) implementing an alternative method of class identification using LCA. The identification of PTSD classes helps to account for patterns in the considerable comorbidity between PTSD and other mental disorders for many PTSD patients. The primary hypothesis was that three classes of veterans would be identified based on MMPI-2 PSY-5 scale data that measure the personality dimensions of interest with an externalizing class characterized by elevations in the aggressiveness and disinhibition scales, an internalizing class characterized by elevations in introversion and a simple PTSD class characterized by PSY-5 scale scores in the normal range, i.e., an absence of personality psychopathology. Both internalizing and externalizing classes were hypothesized to record elevations in negative emotionality. It was hypothesized that these differences on the MMPI-2 PSY-5 scales will also be reflected in differences between the classes on external measures of PTSD comorbidity with the internalizing class reporting greater elevations in anxiety and depression and the externalizing class reporting greater elevations in alcohol use and interpersonal aggression.

Studies seeking to identify externalizing and internalizing classes have to date been conducted using personality psychopathology measures that directly assess the underlying dimensions of interest. This study sought, however, to conduct an additional secondary level LCA to test the extent to which these personality-based classes would also be identifiable on a broader set of parameters, measuring general comorbidity rather than the personality dimensions. It would be expected that comorbidity profiles are likely to be more significantly influenced by current environmental factors, formal and informal treatment processes, and current level of distress compared with the PSY-5, which assesses relatively stable underlying personality traits. However, an LCA of broader comorbidity indicators will provide some insight into the capacity to detect these classes in routine clinical work. As such, this study will conduct a second, more exploratory LCA on the MMPI-2 Restructured Clinical scales (RC scales; Tellegen et al., 2003), which assess a broad array of comorbidity and psychopathology. The RC scales, rather than the original MMPI-2 clinical scales, were selected for this analysis as (unlike the original

MMPI-2 clinical scales) because they were constructed to be independent of each other with no item overlap between the scales.

METHOD

Participants

Participants were 299 male Australian Vietnam veterans with combat-related PTSD attending treatment at a veterans' PTSD program. In terms of ethnicity, participants were almost exclusively Caucasian. PTSD diagnoses were based on structured interview using the Clinician Administered PTSD Scale (CAPS; Blake et al., 1990) administered by trained clinical staff. Participants' mean age was 51.4 ($SD = 4.0$). Mean time since trauma was 27.8 years ($SD = 8.1$). Fifty-five percent of participants served in Vietnam as drafted national servicemen and 45% as regular service personnel. Seventy percent of the participants were receiving compensation from the Department of Veterans Affairs for a medical or psychiatric condition. Thirty-eight percent of the participants were employed and 84% were married at the time of assessment. Comorbidity in the sample (as rated by the assessing clinician using a nonstandardized psychiatric interview) was common, including substance abuse/dependence (56%) and depression (52%).

Measures

Participants completed a range of measures as part of a routine clinical assessment and evaluation procedure prior to commencing the treatment program. Participants provided informed consent prior to completion of the measures. In addition to the MMPI-2 (Butcher et al., 1989), measures of anxiety and depression (The Hospital Anxiety and Depression Scale, HADS; Zigmond & Snaith, 1983), aggression (aggression items from the War Stress Inventory; Johnson et al., 1996) and alcohol use (The Alcohol Use Disorders Identification Test, AUDIT; Babor, de la Fuente, Saunders, & Grant, 1989) were included.

The MMPI-2 (Butcher et al., 1989) is a 567-item self-report measure of personality and broader psychopathology scored on a true/false basis. In addition to the primary 3 validity and 10 clinical scales, the MMPI-2 includes a measure of a 5-factor model of personality, the PSY-5 scales (Harkness, McNulty, Ben-Porath, & Graham, 2002). The PSY-5 scales have demonstrated strong internal consistency, with alpha coefficients ranging from .70–.88 (Harkness et al., 1995) and strong construct validity (Trull, Useda, Costa, & McCrae, 1995). The MMPI-2 also includes Restructured Clinical scales (Tellegen et al., 2003). Following concern about item overlap in the clinical scales, the RC scales were developed by first removing a general emotional distress component from the clinical scales that Tellegen et al. (2003) labeled "demoralization." They next factor-analyzed this demoralization marker with each individual clinical scale to extract distinct core components from each clinical scale. Then new RC scales were designed around these

core components. Thus, the RC scales are a set of nonoverlapping scales that measure a distinct major component of each of the eight original clinical scales in addition to a new measure of general emotional distress, labeled demoralization. These scales have been validated in a range of samples and report strong reliability (Tellegen et al., 2003) and discriminant and convergent validity (Sellbom & Ben-Porath, 2005; Sellbom, Ben-Porath, & Graham, 2006).

The Clinician Administered PTSD Scale (Blake et al., 1990) is a structured interview for PTSD in which the clinician makes a rating for both the frequency and intensity of each of the 17 symptoms of the condition. As recommended by Blake et al. (1990), a frequency score of 1 (0 = *none of the time* to 4 = *most or all of the time*) and an intensity score of 2 (0 = *none* to 4 = *extreme*) was required for a particular symptom to meet criterion for a diagnosis. A severity score for each symptom is calculated by summing the frequency and intensity scores. Thus, the total range of the instrument is 0–136. The mean CAPS severity score for this sample was 79.84 ($SD = 16.58$) reflecting moderate–severe PTSD.

The Combat Exposure Scale (CES; Keane et al., 1989) was included to examine whether the potential subgroups of veterans differed in the nature of their exposure. The CES is a widely used seven item self report measure using a Likert-type response scale. Items on the scale are weighted differentially according to the severity of the experience, with total scores ranging from 0 to 41. Keane et al. (1989) reported that the measure has demonstrated high levels of internal consistency (alpha coefficient = .85) and test-retest reliability (.97) over a 1-week interval. An alpha coefficient of .80 was found in the sample reported here. The mean CES (Keane et al., 1989) score for this sample was 19.15 ($SD = 8.40$) reflecting a moderate level of combat exposure.

The HADS (Zigmond & Snaith, 1983) is a 14-item scale with 7 items relating to anxiety and 7 items relating to depression. It has strong psychometric properties, with high internal consistency ($\alpha = .90$ for depression and .93 for anxiety) and a robust 2-factor structure. Items are scored from 0–3, with total scores ranging from 0–21 for each of the depression and anxiety scales. The anchor questions on each end of the response range on the HADS require the respondent to rate how often they have that symptom. The wording varies across items although most commonly it ranges from *most of the time* to *not at all*. Alpha coefficients in this sample were .81 for both the depression and anxiety subscales.

The Alcohol Use Disorders Identification Test (Babor et al., 1989) is a 10-item scale developed by the World Health Organization as a screening instrument for hazardous and harmful alcohol consumption. Scores of 8 or higher are considered positive for alcohol problems and the scale has demonstrated strong internal reliability (.86; Babor et al., 1989). The alpha coefficient in this sample was .93.

The War Stress Inventory (Johnson et al., 1996) is an outcome measure used by the US Department of Veterans Affairs to monitor treatment effects from their PTSD programs for veterans. Six

items from this inventory were included as measures of aggression. These items include whether in the past month the participant had “threatened someone with physical violence,” “had a physical fight with someone,” “threatened someone with a weapon,” “had thoughts of hurting someone,” “been verbally abusive to someone,” and “used a weapon against someone.” For pragmatic reasons these items were modified to a yes/no format (giving a possible score of 6) compared with the 4-point scale used in the Johnson et al. (1996) study. The decision about changing the War Stress Inventory aggression item to yes/no from a 4-item scale was made by the Australian Centre for Posttraumatic Mental Health in 1996 when developing the dataset and not an alteration made in the context of this study. Using this sample, the measure showed reasonable internal consistency (alpha coefficient of .73).

Data Analysis

Prior to conducting the primary analyses, we removed 3 of the 302 participants in the dataset because they had no MMPI-2 data, resulting in 299 participants. The resulting sample had nominal amounts of missing item-level MMPI-2 data, so we estimated missing values with maximum likelihood procedures (i.e., the expectation maximization algorithm, using all available data to insert values into missing cells) using SPSS' Missing Value Analysis software (Schafer & Graham, 2002). The PSY-5 scale uniform *T*-scores were next calculated manually based on the complete dataset of MMPI-2 items. We further excluded 20 subjects who scored ≥ 80 on VRIN (Variable Response Inconsistency, evidencing random responding) or ≥ 100 on Fp (Infrequency – Psychopathology, evidencing symptom overreporting; no participants evidenced a substantial yeah-saying response set, as would be indicated with scores ≥ 100 on TRIN, True Response Inconsistency). The remaining sample size was 279.

Analyses were conducted in five stages. The first stage involved the conduct of latent class analysis (McLachlan & Peel, 2000; Muthén, 2004), using maximum likelihood estimation with robust standard errors, to assess empirically based classes of respondents based on their PSY-5 total scores. With a sample size of 279, the study had in excess of the minimum sample size of 250 recommended by Nylund et al. (2007) for the use of LCA. Latent class analysis estimated the fit of the class solutions incrementally until no further significant benefit was identified. A difference of 10 points on Bayesian information criterion (BIC) indicates a 150:1 likelihood that the model with the smaller BIC value is the substantially better fitting model (Raftery, 1995). Although a lower BIC indicates better fit, research has demonstrated that the Lo–Mendell–Rubin test is much more reliable in accurately detecting the number of classes (Nylund et al., 2007). As such, the Lo–Mendell–Rubin test was used here to determine the optimal number of classes.

The second stage involved a series of multivariate analyses of variance (MANOVA) that examined differences between the

classes on sets of MMPI-2 PSY-5 scales. Effect size statistics (using η^2) were also calculated where .01–.058 = small effect, .059–.137 = medium effect, and .138 or higher = large effect (Cohen, 1988). The third stage used MANOVA to compare the classes on PTSD severity and combat exposure. The fourth stage of analyses involved the use of MANOVA to validate these classes against additional measures of comorbidity and the use of chi square analyses to compare frequency of ratings in comorbid diagnoses based on psychiatric interview. The fifth stage involved the conduct of a second LCA, this time on the MMPI-2 RC scales directly to assess whether the classes were identifiable when conducted on scales measuring a broader range of comorbidity rather than more personality specific variables.

RESULTS

A latent class analysis was conducted on the PSY-5 scores. A 1-class model yielded a log likelihood of -5396.53 , BIC = 10849.36. A 2-class model resulted in a log likelihood of -5321.03 , BIC = 10732.15, and entropy (denoting the overall proportion of correct class classification) = .69. A 3-class model yielded a log likelihood of -5271.54 , BIC = 10666.97, entropy = .74. A 4-class model yielded a log likelihood of -5245.87 , BIC = 10649.42, entropy = .74.

We found evidence that the 2-class solution was superior to a 1-class solution. Specifically, using the Lo–Mendell–Rubin adjusted likelihood ratio test (Lo, Mendell, & Rubin, 2001), with empirical support for identifying a given model with K classes against a model with $K - 1$ classes (Nylund et al., 2007), the 2-class solution was superior, adjusted Lo–Mendell–Rubin $2LL_{Diff}(6) = 146.66$, $p < .01$. The 3-class solution was not superior to the 2-class solution, adjusted Lo–Mendell–Rubin $2LL_{Diff}(6) = 96.13$, *ns*. Finally, the 4-class solution was superior to the 3-class solution, adjusted Lo–Mendell–Rubin $2LL_{Diff}(6) = 49.86$, $p < .05$, with no solution greater than the 4-class solution representing a better fit.

Stage two of the analysis sought to identify and describe the nature of the differences between the classes identified in the LCA on the PSY-5 scales. The MANOVA of the PSY-5 data was significant, $F(3, 274) = 56.57$, $p < .001$, and a large effect size recorded ($\eta^2 = .51$) as expected given that these were the scales used to determine the classes. Means, standard deviations, and results of Scheffe analyses for each scale can be seen in Figure 1 and Table 1. Scheffe post hoc analyses identified that one class was consistent with externalizing ($n = 55$), recording significantly more elevated scores than both the other three classes on aggressiveness and disconstraint. A second class, consistent with the simple PTSD class ($n = 42$), recorded scores on all five of the PSY-5 scales in the normal range. The two remaining classes appeared consistent with internalizing, although largely differing in terms of extent of scale elevation. The third class—the moderate internalizing class ($n = 97$), was more elevated than the simple PTSD class and the

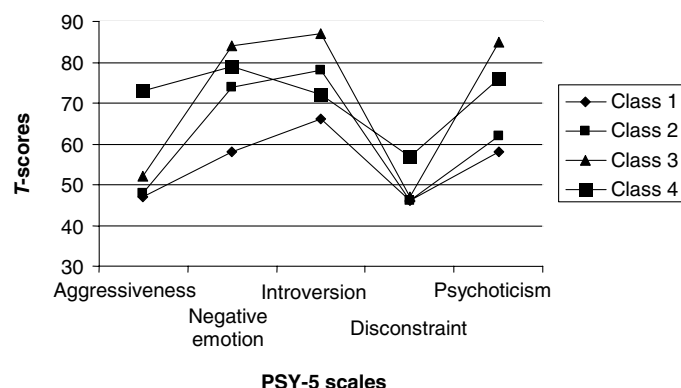


Figure 1. Minnesota Multiphasic Personality Inventory-2 Personality Psychopathology-5 (PSY-5) scale scores for the four classes. Class 1 = simple posttraumatic stress disorder; Class 2 = moderate internalizing; Class 3 = high internalizing; Class 4 = externalizing.

externalizing class on introversion and more elevated than the simple PTSD class on negative emotionality. The fourth class, the high internalizing class ($n = 85$), was more elevated than all three other classes on negative emotionality and introversion. Of note, and potentially also differentiating the moderate and high internalizing classes, were their differences in scale elevation on psychoticism. The high internalizing class was more elevated than all three other classes on psychoticism. By contrast, the medium internalizing class recorded psychoticism scores in the normal range, undifferentiated from the simple PTSD class and significantly lower than both the high internalizing and externalizing classes.

PTSD Severity and Combat Exposure

Univariate ANOVA comparing the four groups on PTSD severity using the CAPS was significant, $F(3, 278) = 6.66$, $p < .001$, $\eta^2 = .075$, with the simple PTSD class reporting less severe PTSD than all three other classes. There were no significant differences between the other classes. Univariate ANOVA failed to identify any differences between the four classes on combat exposure, $F(3, 278) = .28$, ns , $\eta^2 = .003$. Means, standard deviations, and results of analyses for both scales can be seen in Table 2.

Validation of the Classes Using Additional Measures of Comorbidity

To validate the MMPI-2 PSY-5 derived classes against non-MMPI-2 indicators, a MANOVA was conducted to compare the externalizing, moderate and high internalizing, and simple PTSD classes on the HADS Depression, HADS Anxiety, AUDIT Alcohol and War Stress Inventory Aggression scales. The MANOVA was significant, $F(3, 275) = 7.68$, $p < .001$, and a large effect size recorded ($\eta^2 = .12$). Means, standard deviations, and results of analyses for each scale can also be seen in Table 2. In terms of the War Stress Inventory Aggression Scale, Scheffe post hoc analyses identified the externalizing class was more severe than the moderate internalizing class and simple PTSD class. There were no differences between the high and moderate internalizing classes on the War Stress Inventory Aggression Scale, although the high internalizing class was more severe than the simple PTSD class.

In relation to HADS Depression, the high internalizing class was more severe than all three other classes and the moderate internalizing class was more severe than the simple PTSD class. There were no significant differences between the externalizing class and

Table 1. Overall Means and Class Differences on the MMPI-2 PSY-5 Scales

MMPI-2 PSY-5 scales	Overall ($N = 279$)		Simple PTSD (Class 1) ($n = 42$)		Moderate internalizing (Class 2) ($n = 97$)		High internalizing (Class 3) ($n = 85$)		Externalizing (Class 4) ($n = 55$)		F	Class differences	Partial η squared
	M	SD	M	SD	M	SD	M	SD	M	SD			
Aggressiveness	54.42	12.56	47.83	9.64	48.61	7.86	52.04	7.98	73.36	8.05	124.67*	4>1,2,3	.58
Negative emotion	75.61	9.95	58.30	5.53	73.90	5.23	83.75	4.82	79.25	6.78	211.55*	3>4>2>1	.70
Introversion	77.81	12.01	66.07	10.52	77.75	10.12	87.02	7.92	72.65	10.57	51.62*	3>2>4>1	.36
Disconstraint	48.66	9.01	46.40	7.55	45.84	7.23	47.22	7.61	57.56	9.46	29.61*	4>1,2,3	.25
Psychoticism	70.82	15.52	57.79	12.54	61.69	9.94	84.24	11.06	76.01	12.87	82.91*	3>4>2,1	.48

Note. MMPI-2 PSY-5 = Minnesota Multiphasic Personality Inventory-2 Personality Psychopathology-5 scale.

*Class differences significant at $p < .05$.

Table 2. Class Differences From the PSY-5 Latent Class Analysis on PTSD, Combat Exposure, Depression, Anxiety, Alcohol, and Aggression Scales

	Overall (<i>N</i> = 279)		Simple PTSD (Class 1) (<i>n</i> = 42)		Moderate internalizing (Class 2) (<i>n</i> = 97)		High internalizing (Class 3) (<i>n</i> = 85)		Externalizing (Class 4) (<i>n</i> = 55)				Partial η squared
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>F</i>	Class differences	
CAPS													
HADS	79.84	16.58	60.24	15.30	80.31	16.63	82.62	15.74	82.57	15.74	6.67*	2,3,4>1	.08
Depression	11.72	4.15	9.25	4.25	11.47	3.53	14.02	3.66	10.44	4.05	16.77*	3>2,4>1	.17
Anxiety	14.52	3.50	12.30	3.92	14.10	2.86	16.51	3.04	14.42	3.59	16.17*	3>2>1	.17
AUDIT	13.48	10.36	10.18	7.85	12.76	10.14	14.83	11.58	15.35	10.10	3.62*	4>1	.03
WSI Aggression	2.18	1.15	1.23	1.15	1.92	1.28	2.50	1.36	2.91	1.27	15.16*	4>2>1; 3>1	.15
CES	19.15	8.40	19.55	9.07	18.62	8.04	19.73	7.56	18.94	8.03	0.27		.00

Note. PTSD = posttraumatic stress disorder; PSY-5 = Personality Psychopathology-5; CAPS = Clinician Administered PTSD Scale; HADS = Hospital Anxiety and Depression Scale; AUDIT = Alcohol Use Disorders Identification Test; WSI = War Stress Inventory; CES = Combat Exposure Scale.

*Class differences significant at $p < .05$.

the simple PTSD class or the moderate internalizing class. In terms of HADS Anxiety, the high internalizing class, as with HADS Depression, was more severe than all three other classes and the simple PTSD class was less severe than the high internalizing and externalizing classes. In terms of the AUDIT Alcohol scale, the only significant difference was that the externalizing class reported greater severity of alcohol use problems than the simple PTSD class.

Chi square analyses examining differences between the classes on the basis of unstructured clinical psychiatric interview supported the above findings, with psychiatrists more frequently diagnosing depression in the high and moderate internalizing classes than the externalizing class, $\chi^2(2, N = 279) = 14.12, p < .01, \phi = .23$, and diagnosing alcohol use disorder more frequently in the externalizing class than the internalizing classes, $\chi^2(2, N = 279) = 4.34, p < .05, \phi = .19$. There were no differences between the classes in the identification of comorbid anxiety disorders, $\chi^2(2, N = 279) = 3.90, ns, \phi = .12$.

Conduct of Additional LCA for Validation on the MMPI-2 Restructured Clinical Scales

In terms of further assessing the strength of the model of varied comorbidity profiles on the basis of internalizing and externalizing PTSD class membership it was important to test whether these classes were evident when attempting to identify them using a broader array of measures of psychopathology and comorbidity rather than personality variables that more directly assess the dimensions of interest.

The previous approach to LCA was repeated, although this time using the MMPI-2 restructured clinical scales (Tellegen, 2003).

The 1-class model yielded a log-likelihood of -9746.07 , BIC = 19593.51 . A 2-class model resulted in a log-likelihood of -9424.74 , BIC = 19007.16 , and entropy (denoting the overall proportion of correct class classification) = $.86$. A 3-class model yielded a log-likelihood of -9309.87 , BIC = 18833.72 , entropy = $.86$. A 4-class model yielded a log-likelihood of -9252.52 , BIC = 18775.33 , entropy = $.88$. We found evidence that the 2-class solution was superior to a 1-class solution, adjusted Lo-Mendell-Rubin $2LL_{Diff}(10) = 631.45, p < .01$, the 3-class solution was superior to the 2-class solution, adjusted Lo-Mendell-Rubin $2LL_{Diff}(10) = 225.74, p < .01$; however, the 4-class was not superior to the 3-class solution, adjusted Lo-Mendell-Rubin $2LL_{Diff}(10) = 112.70, ns$.

The MANOVA of the RC scales data (against the three classes) was significant, $F(2, 270) = 38.26, p < .001$, and a large effect size recorded ($\eta^2 = .56$) as expected given that these were the scales used to determine the classes. Means, standard deviations, and results of Scheffe analyses for each scale can be seen in Table 3. Unlike the LCA conducted on the PSY-5 data, the classes appear to be somewhat more influenced by profile severity. A simple PTSD class with profile scores in the normal range was identified. In addition, the internalizing and externalizing conceptualization was still evident. Only on the scales most likely to reflect externalizing (RC3 cynicism; RC4 antisocial behavior, and RC9 hypomanic activation) was there a departure from the usual pattern of differentiation on the basis of severity. On all of these three scales, the most elevated class was more severe than the other two classes, which were not different from each other. This moderate class, therefore, was most consistent with the moderate internalizing class identified in the PSY-5 LCA.

Table 3. Overall Means and Class Differences on the MMPI-2 Revised Clinical Scales

MMPI-2 Revised Clinical scales	Overall (<i>N</i> = 279)		Simple PTSD (Class 1) (<i>n</i> = 49)		Moderate internalizing (Class 2) (<i>n</i> = 108)		Severe (Class 3) (<i>n</i> = 122)		<i>F</i>	Class differences	Partial η^2 squared
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Demoralization	78.20	9.31	62.14	6.53	78.61	5.39	84.29	3.84	340.70*	3>2>1	.71
RC1	83.76	14.11	67.28	12.43	80.62	11.21	93.15	8.79	114.66*	3>2>1	.45
RC2	77.35	12.73	60.46	9.21	78.69	10.13	82.94	9.98	91.42*	3>2>1	.39
RC3	60.98	11.65	52.77	9.08	56.87	10.23	67.92	9.77	56.82*	3>2,1	.29
RC4	60.58	9.84	56.18	9.09	57.05	9.31	65.48	8.38	33.14*	3>1,2	.19
RC6	63.53	13.86	51.46	11.79	59.26	10.91	72.14	11.45	70.94*	3>2>1	.34
RC7	75.82	11.41	62.04	9.15	71.87	8.28	84.84	5.71	188.26*	3>2>1	.57
RC8	73.08	13.75	60.93	9.82	66.56	10.09	83.72	9.70	131.41*	3>2>1	.49
RC9	54.37	10.23	51.30	8.92	50.30	7.84	59.20	10.60	29.29*	3>2,1	.18

Note. MMPI-2 = Minnesota Multiphasic Personality Inventory-2; RC1 = Somatic complaints; RC2 = low positive emotions; RC3 = cynicism; RC4 = antisocial behaviors; RC6 = ideas of persecution; RC7 = dysfunctional negative emotions; RC8 = aberrant experiences; RC9 = hypomanic activation.

*Class differences significant at $p < .05$.

DISCUSSION

This study sought to identify classes of veterans with combat-related PTSD based on an internalization and externalization model using an alternate form of statistical analysis, latent class analysis. Overall, the results of the PSY-5 LCA supported the hypothesis that combat veterans with PTSD can be categorized on the basis of a personality and psychopathology profile consistent with internalizing and externalizing. Interestingly, this analysis identified a 4- (rather than 3-) class solution as best fitting the data. The classes identified appeared consistent with a simple PTSD class, with personality scores in the normal range, an externalizing class and two classes consistent with internalizing, although differing considerably in severity or extent of elevation, subsequently labeled moderate internalizing and high internalizing. Another important differentiation between the moderate and high internalizing classes was that the high internalizing class recorded significant elevations in psychoticism whereas the moderate internalizers recorded scores on this scale in the normal range.

The externalizing class was characterized by elevations in the PSY-5 scale profile on aggressiveness and disconstraint. These differences were reflected in external measures of comorbidity, with the externalizing class reporting greater elevations in WSI Aggression than the moderate internalizing and simple PTSD classes and in more elevated AUDIT Alcohol Scores than the simple PTSD class. This class was also more likely to have a psychiatrist-diagnosed alcohol use disorder than the high internalizing class.

The high internalizing class was characterized by greater elevations in negative emotionality, introversion, and psychoticism than all three other classes. This was supported by greater elevations

than all three other classes on HADS Depression and HADS Anxiety scales and greater likelihood of a psychiatrist-diagnosed depressive disorder than the externalizing class. Somewhat similarly, the moderate internalizing class was characterized by greater elevation on introversion than the externalizing and simple PTSD classes and negative emotionality compared with the simple PTSD class. Fewer differences were identified between this class and the externalizing class on the HADS Depression and Anxiety scales, although the moderate internalizing class was also more likely to have a psychiatrist-diagnosed depressive disorder than the externalizing class.

In terms of understanding the implications of the finding of an optimal 4-, rather than 3-class structure it is worth considering the implications of the elevation of the psychoticism scale in the high internalizers. Psychoticism in the PSY-5 is best considered a measure of "thinking away from reality" (Harkness et al., 1995, p. 105) and of the "gross verisimilitude of our inner models of the outer social and object world." It is highly correlated with negative emotionality on the Multidimensional Personality Questionnaire (Tellegen, 1985), but also with absorption and alienation (Harkness et al., 1995). Therefore, an internalizing subclass with a propensity for psychoticism marks an important differentiation within the internalizing class range. Although not available here, it would be expected that this class would be differentiated from all three other classes on independent measures of dissociation and possibly schizotypal personality disorder.

Although the current LCA identifies meaningful differentiations of two internalizing subclasses, the findings are also consistent with a more parsimonious 3-class model based on internalizing, externalizing, and those with scores in the normal range. Of note

also is the significantly larger numbers in the internalizing classes compared with the externalizing class. This finding is consistent with those of Miller et al. (2003, 2004).

Further light can be shed on the differentiations between classes when considering the results of the LCA on the RC scales. As outlined previously, it would be expected that classes identified using LCA on nonpersonality-based broader measures of psychopathology or comorbidity profile are likely to be more significantly influenced by current environmental factors, formal and informal treatment processes, and current level of distress compared with the PSY-5, which assesses relatively stable underlying personality traits.

The value of such an LCA on these measures, however, is to provide some insight into the capacity to detect these classes in routine clinical work. The findings of this LCA were consistent with these expectations, with results appearing more influenced by scale elevation than the LCA on the PSY-5 personality-based dimensions. The low and moderate classes appeared consistent with the simple PTSD and medium internalizing classes, respectively, with the low class reporting profile scores in the normal range and the moderate class reporting elevations in scores reflective of internalizing (demoralization, somatic complaints, low positive emotions and dysfunctional negative emotions) and low scores on externalizing type scales of cynicism, antisocial behaviors, and hypomanic activation. The third "severe" class, however, appeared to combine a vast majority of the externalizing and high internalizing class members and features. It may be that high internalizing with a propensity for psychoticism and the externalizing classes are less distinguishable when class membership is identified using broader measures of psychopathology such as the RC scales (rather than the PSY-5 scales) at the more severe end of the spectrum. In this context, the propensity for more bizarre and possibly persecutory mentation, alienation, and irritability and agitation, consistent with high scores on psychoticism, results in elevations on measures of cynicism, antisocial behavior, and hypomanic activations, albeit for different reasons from that of the externalizing class. Overall, although the findings of the internalizing/externalizing model were less obvious in the LCA on the broader comorbidity scales (the RC scales), some evidence of the model was still apparent and some indications for the manner in which these classes may be distinguished using broader psychopathology measures were identified.

In the absence of longitudinal prospective data we are unable to answer the question of the degree to which these propensities for internalizing and externalizing influenced the development of PTSD and manifest comorbidity in this sample or, indeed, whether they were present pretrauma. However, models of the interactions between personality and psychopathology would posit a range of ways to conceptualize the phenomena under consideration in this article. These models include (a) the diathesis stress model where the stressor precipitates the disorder mediated by personality in the manner in which it influences perception and cognitive set

toward the stressor; (b) models that emphasize the role of personality pathology and temperament in modifying the course or expression of a disorder without having a direct etiological role through, for example, shaping environmental contributions to the maintenance of disorder (Wachtel, 1994); (c) the scar hypothesis, which suggests that the experience of psychiatric disorder impacts on personality (Akiskal et al., 1983); and finally (d) the continuity hypothesis, which states that both the personality and psychiatric disorder reflect the same underlying process, with disorders reflecting extreme variants of the normal personality traits (Hirschfeld & Klerman, 1979). In all of these hypotheses, however, there is an underlying acknowledgment of the complex interactions between personality and psychopathology.

As such, in conceptualizing the nature of these classes we might expect that they reflect the reciprocal relationships between (a) internalizing and externalizing personality factors; (b) the nature of the traumatic event and the manner in which the event was experienced (for example, the potential to process the traumatic event in terms of "self-blame" compared to "other blame"); and (c) subsequent morbidity, coping styles (for example, acting out and risk taking compared to social isolation and rumination), and the life circumstances which follow. These relationships, of course, are not absolute, as evidenced by the dilution in the representation of these classes when broader psychopathology rather personality-based indicators are used. The nature of comorbidities largely associated with the internalizing and externalizing classes is, however, consistent with the clustering of these morbidities in confirmatory factor analyses that identify latent factors (Krueger, 1999; Miller et al., 2008).

The fact that an internalizing and externalizing model of personality and comorbid psychopathology holds up when examining personality psychopathology data in a non-North American sample of combat veterans, using an alternative statistical approach, is an important step in validating this model. Despite considerable previous work identifying classes on the basis of personality and broader psychopathology (e.g., Elhai et al., 2003; Forbes et al., 2003; Hyler, Davis, Albrecht, Boudewyns, & Wood, 1994; Piekarski et al., 1993) the absence of a unifying conceptual model, and the fact that earlier studies adopted an exploratory approach, resulted in the failure to identify consistencies across these classes and hence to gain benefit from a growing body of evidence.

This study also adds to the existing literature through the identification of potential subclasses within the internalizing spectrum where, at more severe ends of this dimension, traits measured by the PSY-5 psychoticism scale such as absorption and alienation become more prominent. The study also suggests that although the simple PTSD and moderate internalizing classes may be identifiable when measures of broader psychopathology are used to detect classes directly, the high internalizing and externalizing classes may be less distinguishable on these measures.

Importantly, the internalization/externalization model forms the basis for building a systematic body of work to inform the role

of assessment in tailoring engagement and intervention approaches to people with PTSD and related conditions. Some support for the potential implications of these classes for tailoring treatment can be found in the findings by Forbes et al. (2003) that classes (reported as subgroups) respectively identified as disinhibition/externalization and somatization/introversion differed in the longer-term trajectory following treatment. It might be speculated, for example, that veterans in the internalizing class would respond to trauma-focused psychological treatment (such as prolonged exposure or cognitive therapy), while those in the externalizing class may benefit, particularly in the initial stages, from skills-based symptom management approaches (particularly those aimed at substance use and anger). Early addressing of anger, aggression, and substance abuse for the externalizing class may be important, not only to ensure that priority issues of safety are addressed in the context of aggression, but also to address the negative impact of substance use on the capacity to benefit from trauma-focused treatment. In addition, there is now emerging evidence of the combination of anger and substance use problems in military veterans limiting the effects of treatment (Forbes et al., 2008).

The identification in this study of the two subclasses of internalizing also has implications for treatment. Aside from severity, one notable difference between these classes was the propensity for psychoticism, which on the PSY-5 measures "thinking away from reality" and is correlated with absorption. Although the moderate internalizing class would likely benefit from standard trauma focussed interventions (exposure and cognitive therapy), some further focus on grounding and arousal management strategies prior to trauma-focussed treatment would likely be useful for the high internalizers in view of the potential for absorption and possibly dissociation to ensure adequate emotional processing during trauma-focused interventions.

There are two primary limitations to the interpretations of this study. First, the key variables of interest in determining class membership were collected using self-report rather than structured interview data. Also while PTSD was determined by structured clinical interview, comorbid diagnoses were determined through unstructured clinical psychiatric interview and completion of self-report measures. Although constituting only one part of the current analyses, these measures are important in providing evidence for the concurrent validity of the classes. Second, these data are drawn from combat veterans and the generalization of these findings to survivors of other types of trauma using LCA techniques still needs to be established. Future research should focus on attempts to replicate these findings using LCA techniques with survivors of nonmilitary trauma using structured interview procedures and assess the influence of this categorization on treatment outcome.

In summary, these findings lend important support to the proposal that classes of combat-related PTSD can be distinguished on the basis of personality and psychopathology profiles largely consistent with internalizing and externalizing. The findings have

important implications for assessment strategies and individual tailoring of treatment to achieve better and more consistent outcomes.

REFERENCES

- Akiskal, H. S. (1983). Dysthymic disorder: Psychopathology of proposed chronic depressive subtypes. *American Journal of Psychiatry*, 140, 11–20.
- American Psychiatric Association. (1994). *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition. Washington DC: Author.
- Babor, T. F., de la Fuente, J. R., Saunders, J., & Grant, M. (1989). AUDIT—The Alcohol Use Disorders Identification Test: Guidelines for use in primary health care. Geneva: World Health Organisation, Division of Mental Health.
- Blake, D. D., Weathers, F. W., Nagy, L. M., Kaloupek, D. G., Klauminzer, G., Charney, D. S., et al. (1990). A clinician rating scale for assessing current and lifetime PTSD: The CAPS-1. *The Behavior Therapist*, 13, 187–188.
- Butcher, J. N., Dahlstrom, W. G., Graham, J. R., Tellegen, A., & Kaemmer, B. (1989). *The Minnesota Multiphasic Personality Inventory-2 (MMPI-2): Manual for administration and scoring*. Minneapolis, MN: University of Minnesota Press.
- Clark, L. A. (1996). SNAP—Schedule for Nonadaptive and Adaptive Personality: Manual for administration, scoring, and interpretation. Minneapolis: University of Minnesota Press.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Creamer, M., Burgess, P., & McFarlane, A. C. (2001). Post-traumatic stress disorder: Findings from the Australian National Survey of Mental Health and Well-being. *Psychological Medicine*, 31, 1237–1247.
- Elhai, J. D., Frueh, B. C., Davis, J. L., Jacobs, G. A., & Hamner, M. B. (2003). Clinical presentations in combat veterans diagnosed with posttraumatic stress disorder. *Journal of Clinical Psychology*, 59, 385–397.
- Forbes, D., Creamer, M., Allen, N., Elliott, P., McHugh, A., Debenham, P., et al. (2003). MMPI-2 based subgroups of veterans with combat-related PTSD: Differential patterns of symptom change after treatment. *Journal of Nervous and Mental Disease*, 191, 531–537.
- Forbes, D., Parslow, R., Creamer, M., Allen, N., McHugh, T., & Hopwood, M. (2008). Mechanisms of anger and treatment outcome in preliminary investigation into the veterans with posttraumatic stress disorder. *Journal of Traumatic Stress*, 21, 142–149.
- Harkness, A. R., McNulty, J. L., & Ben-Porath, Y. S. (1995). The Personality Psychopathology Five (PSY-5): Constructs and MMPI-2 scales. *Psychological Assessment*, 7, 104–114.
- Harkness, A. R., McNulty, J. L., Ben-Porath, Y. S., & Graham, J. R. (2002). *MMPI-2 Personality Psychopathology Five (PSY-5) Scales*. Minneapolis, MN: University of Minnesota Press.
- Hirschfeld, R. M., & Klerman, G. L. (1979). Personality attributes and affective disorders. *American Journal of Psychiatry*, 136, 67–70.
- Hyler, L., Davis, H., Albrecht, W., Boudewyns, P. A., & Woods, G. (1994). Cluster analysis of MCMI and MCMI-II on chronic PTSD victims. *Journal of Clinical Psychology*, 50, 502–515.
- Hyler, L. A., Davis, H., Albrecht, W., Boudewyns, P., & Woods, G. (1994). Cluster analysis of MCMI and MCMI-II on chronic PTSD victims. *Journal of Clinical Psychology*, 50, 502–515.
- Johnson, D. R., Rosenheck, R., Fontana, A., Lubin, H., Charney, D., & Southwick, S. (1996). Outcome of intensive inpatient treatment for combat-related posttraumatic stress disorder. *American Journal of Psychiatry*, 153, 771–777.

- Keane, T. M., Fairbank, J. A., Caddell, J. M., Zimering, R. T., Taylor, K. L., & Mora, C. A. (1989). Clinical evaluation of a measure to assess combat exposure. *Psychological Assessment*, 1, 53–55.
- Kessler, R. C., Sonnega, A., Hughes, M., & Nelson, C. B. (1995). Posttraumatic stress disorder in the National Comorbidity Survey. *Archives of General Psychiatry*, 52, 1048–1060.
- Krueger, R. F. (1999). The structure of common mental disorders. *Archives of General Psychiatry*, 56, 921–926.
- Lo, Y., Mendell, N., & Rubin, D. B. (2001). Testing the number of components in a normal mixture. *Biometrika*, 88, 767–778.
- McLachlan, G. J., & Peel, D. (2000). *Finite mixture models*. New York: Wiley.
- Miller, M. W., Fogler, J. M., Wolf, E. J., Kaloupek, D. G., & Keane, T. M. (2008). The internalizing and externalizing structure of psychiatric comorbidity in combat veterans. *Journal of Traumatic Stress*, 21, 58–65.
- Miller, M. W., Greif, J. L., & Smith, A. A. (2003). Multidimensional Personality Questionnaire profiles of veterans with traumatic combat exposure: Externalizing and internalizing subtypes. *Psychological Assessment*, 15, 205–215.
- Miller, M. W., Kaloupek, D. G., Dillon, A. L., & Keane, T. M. (2004). Externalizing and internalizing subtypes of combat-related PTSD: A replication and extension using the PSY-5 scales. *Journal of Abnormal Psychology*, 113, 636–645.
- Miller, M. W., & Resick, P. A. (2007). Internalizing and externalizing subtypes in female sexual assault survivors: Implications for the understanding of complex PTSD. *Behavior Therapy*, 38, 58–71.
- Miller, M. W., Fogler, J. M., Wolf, E. J., Kaloupek, D. G., & Keane, T. M. (2008). The internalizing and externalizing structure of psychiatric comorbidity in combat veterans. *Journal of Traumatic Stress*, 21, 58–65.
- Millon, T., Millon, C., & Davis, G. (1994). *MCMI-III manual*. Minneapolis: National Computer Systems.
- Muthén, B. O. (2004). Latent variable analysis: Growth mixture modeling and related techniques for longitudinal data. In D. Kaplan (Ed.), *Handbook of quantitative methodology for the social sciences* (pp. 345–368). Newbury Park, CA: Sage.
- Nylund, K. L., Asparouhov, T., & Muthén, B. O. (2007). Deciding on the number of classes in latent class analysis and growth mixture modeling: A Monte Carlo simulation study. *Structural Equation Modeling: A Multidisciplinary Journal*, 14, 535–569.
- Piekarski, A. M., Sherwood, R., & Funari, D. J. (1993). Personality subgroups in an inpatient Vietnam veteran treatment program. *Psychological Reports*, 72, 667–674.
- Raftery, A. E. (1995). Bayesian model selection in social research. *Sociological Methodology*, 25, 111–163.
- Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods*, 7, 147–177.
- Sellbom, M., & Bagby, R.M. (2009). Identifying PTSD personality subtypes in a workplace trauma sample. *Journal of Traumatic Stress*, 22, 471–475.
- Sellbom, M., & Ben-Porath, Y. S. (2005). Mapping the MMPI-2 Restructured Clinical (RC) Scales onto normal personality traits: Evidence of construct validity. *Journal of Personality Assessment*, 85, 179–187.
- Sellbom, M., Ben Porath, Y. S., & Graham, J. R. (2006). Correlates of the MMPI-2 Restructured Clinical (RC) scales in a college counselling setting. *Journal of Personality Assessment*, 86, 89–99.
- Slade, T., & Watson, D. (2006). The structure of common DSM-IV and ICD-10 mental disorders in the Australian general population. *Psychological Medicine*, 36, 1593–1600.
- Tellegen, A. (1985). *Brief manual for the Multidimensional Personality Questionnaire*. Minneapolis: University of Minnesota Press.
- Tellegen, A., Ben Porath, Y. S., McNulty, J. L., Arbisi, P. A., Graham, J. R. & Kaemmer, B. (2003). *MMPI-2 Restructured Clinical (RC) Scales: Development, validation and interpretation*. Minneapolis: University of Minnesota Press.
- Trull, T. J. (1993). Temporal stability and validity of two personality disorder inventories. *Psychological Assessment*, 5, 11–18.
- Trull, T. J., Useda, J. D., Costa, P. T., & McCrae, R. R. (1995). Comparison of the MMPI-2 Personality Psychopathology Five (PSY-5) the NEO-PI, and NEO-PI-R. *Psychological Assessment*, 7, 508–516.
- Vollebergh, W. A., Iedema, J., Bijl, R. V., de Graaf, R., Smit, F., & Ormel, J. (2001). The structure and stability of common mental disorders: The NEMESIS study. *Archives of General Psychiatry*, 58, 597–603.
- Wachtel, P. L. (1994). Cyclical processes in personality and psychopathology. *Journal of Abnormal Psychology*, 103, 51–66.
- Zigmond, A., & Snaith, R. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatrica Scandinavica*, 67, 361–370.